Research Application Summary

Improving maize-beans yields through improved soil moisture storage using trapezoidal bunds and manure in Machakos County-Eastern Kenya

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Abstract

The tremendous increase in population in Kenya has created the need for faster rate of increase in food production. However, more than 80% of Kenya lies in the arid and semi arid lands (ASALs). To mitigate food shortages in such areas, there is an urgent need to put into practice technologies that enhance moisture storage in soils and improve crop yields. This study which is in progress is investigating the effects of trapezoidal bunds and manure on moisture storage in soils and maize – beans intercrop yields in the semi-arid parts of Eastern Kenya. Trapezoidal bunds for rainfall run-off water collection have been constructed according to the recommended patterns. The experiment plot sizes are 4.5 m × 4.5 m where maize and beans are planted as the test crops, and manures (0, 5, 10 ton/ha) and N P (0, 50, 75 kg /ha) fertilisers as sources of plant nutrients. The experiment is a factorial arranged in a randomised complete block design. Data will be subjected to analysis of variance using the general linear model of the SAS software. Treatment differences will be examined using Tukey-Kramer significant difference (HSD) test. Regression and correlation analyses between various variables will be done to draw key relationships. Outputs of this study will include improved crop yields, increased knowledge of trapezoidal bunds technology usage and improved food security in the ASALs of Kenya.

Key words: Kenya, maize-beans yields, moisture storage, trapezoidal bunds

Résumé

L'augmentation considérable de la population du Kenya a créé la nécessité d'accélérer le taux de croissance de la production alimentaire. Cependant, plus de 80% dela superficie du Kenya se trouve dans les terres arides et semi-arides (ASALs). Afin d'atténuer les pénuries alimentaires dans ces régions, il est urgent de mettre en pratique les technologies qui améliorent la rétention d'humidité dans les sols et augmententles rendements des cultures. Cette étude,qui est en cours,recherche les effets des diguettes trapézoïdales et du fumier sur la rétention

d'humidité dans les sols et les rendements des cultures intercalaires de maïs-haricots dans les régions semi-arides de l'Est du Kenya. Les diguettes trapézoïdales pour la collecte d'eau de ruissellement des pluies ont été construites selon les modèles recommandés. Les dimensions des parcelles expérimentales sont de 4,5 m × 4,5 m là où le maïs et les haricots sont plantés comme des cultures d'essai, et les fumiers (0, 5, 10 t / ha) et les engrais NP (0, 50, 75 kg / ha) en tant que sources des nutriments des plantes. L'expérience est un factoriel arrangé en conception des blocs complets randomisés. Les données seront soumises à une analyse de la variance en utilisant le modèle linéaire général du logiciel SAS. Les différences de traitement seront examinées à l'aide du test de différence significative de Tukey-Kramer (HSD). Les analyses de régression et de corrélation entre les différentes variables seront faites pour tirerles relations clés. Les résultats de cette étude comprendrontle rendement amélioré des cultures, la connaissance accrue de l'utilisation des technologies des diguettes trapézoïdales et la sécurité alimentaire améliorée dans les ASALs du Kenya.

Mots clés: Kenya, rendements du maïs-haricots, rétention d'humidité, diguettes trapézoïdales

Background

Agriculture is an important development vehicle for achieving the Millennium Development Goal (MDG) in Kenya and reducing the share of people suffering from extreme poverty and hunger by 2015. Yet food production in Kenya has been on the decline for the last three decades (FAO, 2002). Limited good agricultural land (12%), declining soil fertility, impact of climate change and rapid population estimated at 2.8% per annum have been cited as some of the main contributing factors (Mochoge and Danga, 2010). The pressure on good arable land due to high population growth rates has pushed serious farming to marginal arid and semi-arid lands (ASALs) which are fragile ecosystems easily prone to quick degradation and yet occupy more than 80% of the total land. In this region, efforts to achieve food security, reduce poverty and improve people's livelihoods are hampered by adverse effects of biophysical factors such as low and erratic rainfall, low soil fertility, and low use of manure and mineral fertilisers (Giller *et al*., 1997). To improve food production in dry-lands and to reduce poverty, new strategies that enhance soil and water management have to be developed and implemented. This includes conservation tillage, rain water harvesting (RWH) and production of high value market crops

(Ngigi 2001; Ekaya, 2007). Research to improve food production in dry-lands and to reduce poverty has concentrated on new strategies to enhance soil and water management (Prinz, 1994; Ekaya, 2007). Increased soil moisture also enhances nutrients use efficiency. Crop productivity in semi-arid Kenya is generally low. Maize (*Zea mays* L.) yields range between 240 to 750 kg/ha per season in farmers fields and that of beans around 150 kg/ha. In fertiliser use experiment carried out in semi-arid parts of Kenya, Mochoge *et al*. (1997) recorded maize yields of between 370 and 940 kg ha^{-1} from unfertilised plots, between 900 and 2010 kg/ha from NP fertilised plots and 700-1720 kg/ha from manure applied plots. However, in plots where NP fertilisers were combined with manure, higher yields (1000-2280 kg/ha) were obtained. The use of a mixture of organic manure has also resulted in reduced rates of inorganic fertilisers, which might be a promising approach to low maize productivity. On the basis of the foregoing, therefore, application of manure and inorganic fertilisers appear to be a reasonable and cost effective approach to enhance crop yield. Therefore the aim of this study is to investigate the effects of trapezoidal bunds and manure application on maize-beans yield and soil moisture conservation in the semi-arid parts of Eastern Kenya.

Study Description

The field experiments are being conducted at Katumani, Machakos County in the semi-arid parts of Eastern Kenya. The site represents low midlands, agro-ecological zone**.** Trapezoidal bunds have been constructed on a 2% slope by hand and according to the recommended procedure. Treatments will comprise three levels of manure (0, 5 and10 tons/ha) and 0.50 and 75 kg/ha of NP fertilizers application. Phosphate fertiliser (TSP-46% P_2O_5) and CAN (26%) for nitrogen fertiliser will be used. Maize (SC Duma 43) and common bean are the test crops and the study will be conducted for two seasons. The trial will be a factorial, arranged as a randomised in a complete block. Experimental plots measure 4.5m x 4.5m. Soil sampling will be done at the start and end of each season. Soils will be sampled from 3 depths: 0-20, 20-40 and 40-60 cm. Soil for dynamic changes (mainly available N and P, and water soil changes) will be obtained from 2 depths (0-20 and 20-40cm). Dynamic N changes in soil will be measured in terms of available nitrogen (NH_4 and NO_3) and analysed by filtration, steam distillation-titration method according to the modified Kjedahl technique (Frede *et al*., 1976). Soil texture, dry bulk density, soil pH, CEC and exchangeable cations will be determined at the beginning and at the end of experiment.

Three plants of maize will be sampled randomly at seedling, milk stage and at harvest for total nitrogen determination. These samples will be collected in paper bags and oven dried at 40°C for 72 hours. Grain yield data will be determined at 12.5% moisture content. Data will be subjected to analysis of variance using the general linear model of the SAS software. Treatment differences will be examined using Tukey-Kramer significant difference (HSD) test. Regression and correlation analyses between various variables will be done to draw key relationships.

Research Application

The trapezoidal bund technology though initially labour intensive has a lot of advantages to the low income farmers. It increases water storage in soils within its structures and extends the duration of water retention in soil. This study is intended to demonstrate that trapezoidal bund technology improves water and nutrient use efficiency and hence increases crop yields.

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